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Selected US specifications from IPC sub-classes H04Q  
G08C

## (54) Automatic identification of living creatures and objects

(57) A central processor 60, via a nodal processor 40, controls polling units 20/1 .....20/N each of which transmits repeatedly a series of addresses each address followed by a gap for a response. Living creatures or objects (mobile) to be identified carry respective automatic response means 10. When a means 10 is in range and receives its own address it transmits a response signal to the polling unit.

The polling units may be connected in a ring.

There may be a single polling unit which moves past response means carried by entombed miners.

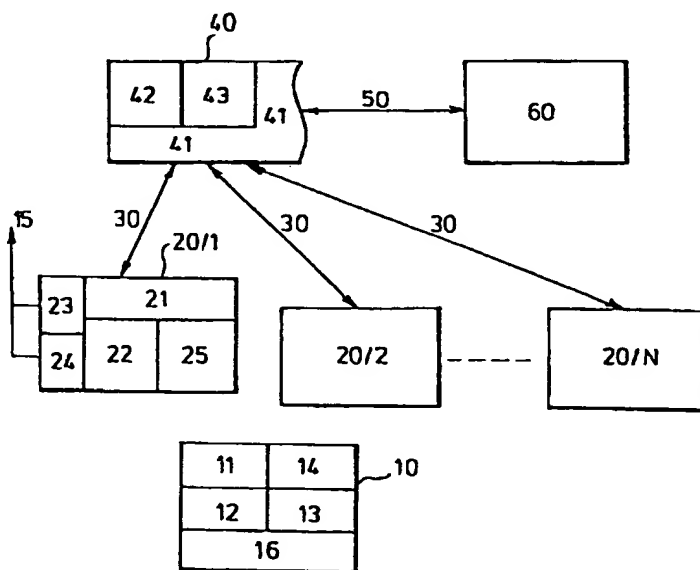


Fig. 2

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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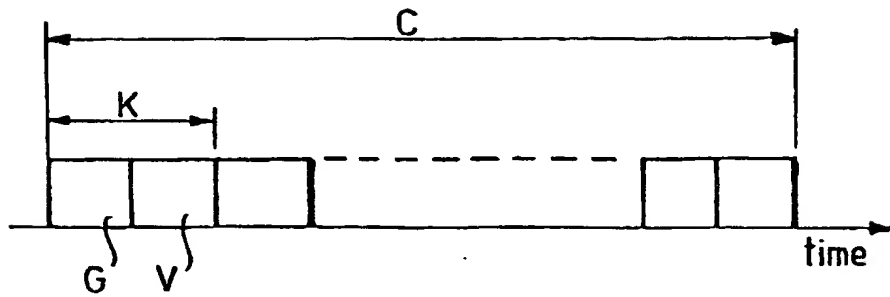


Fig.1

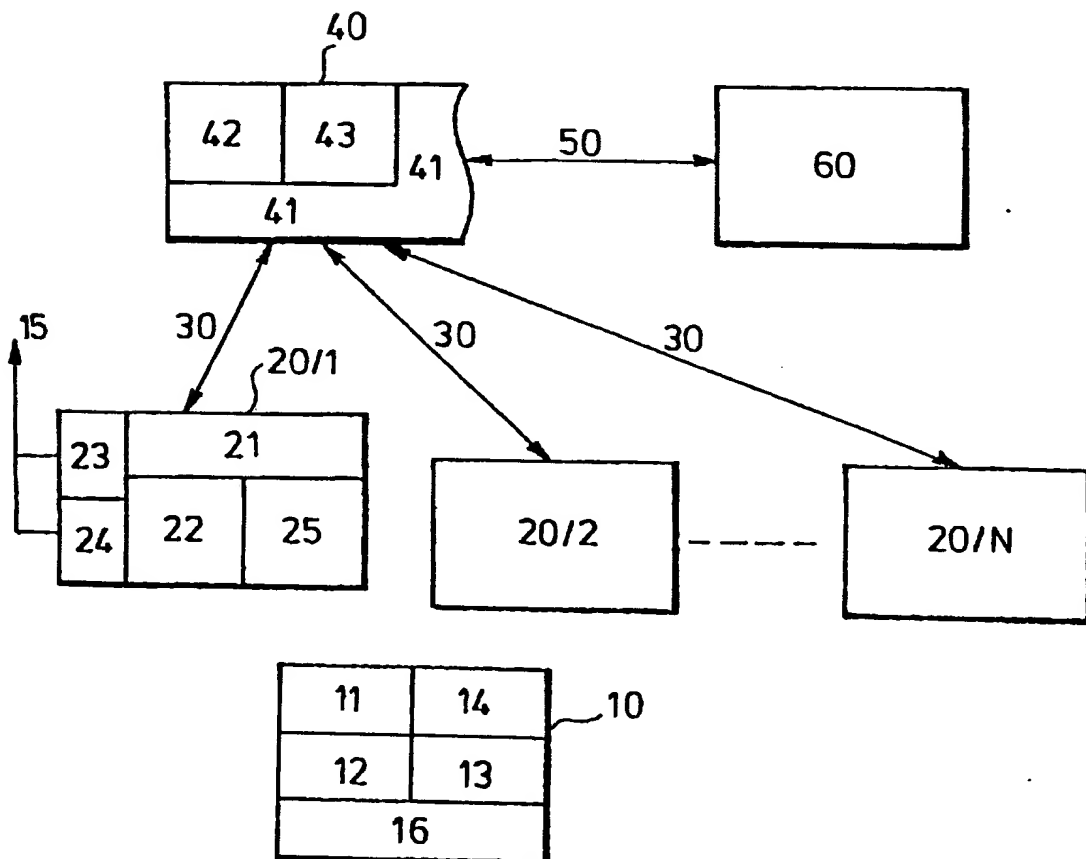


Fig.2

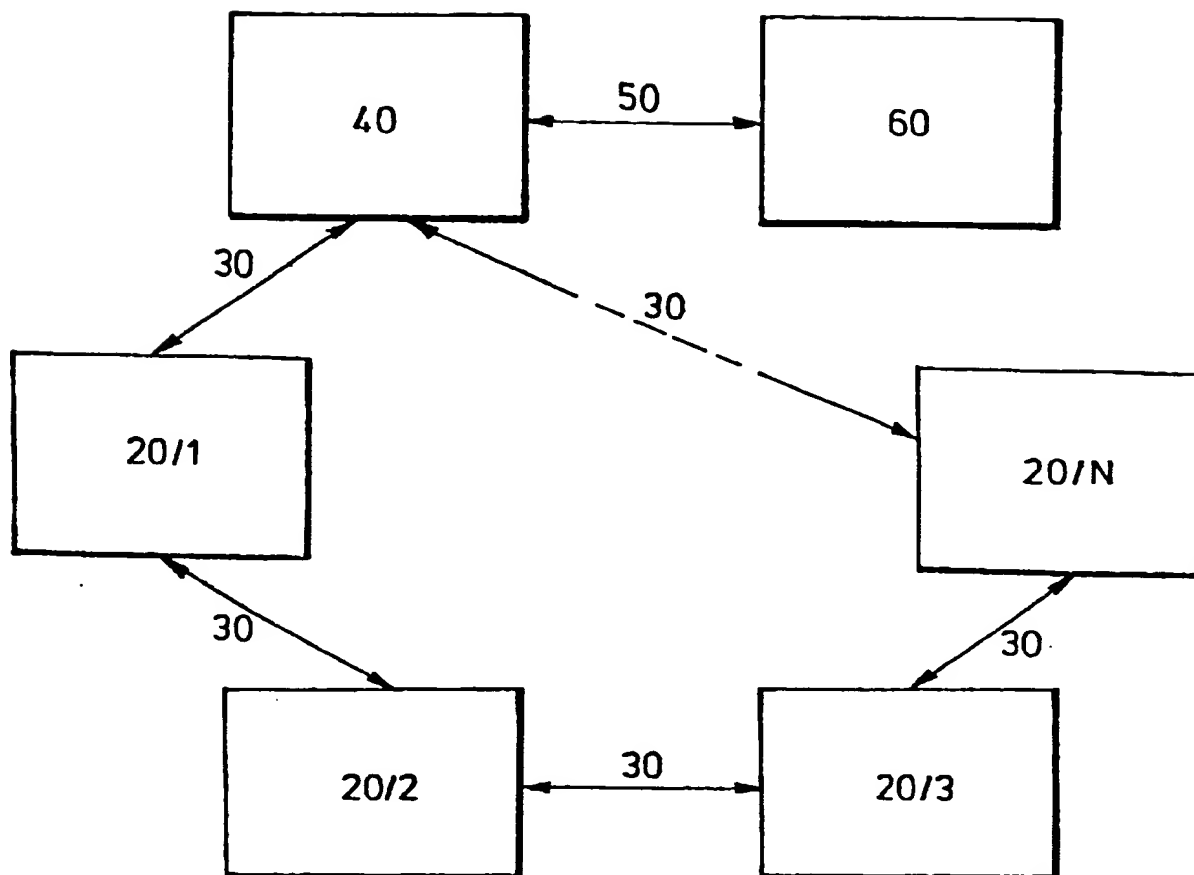


Fig. 3

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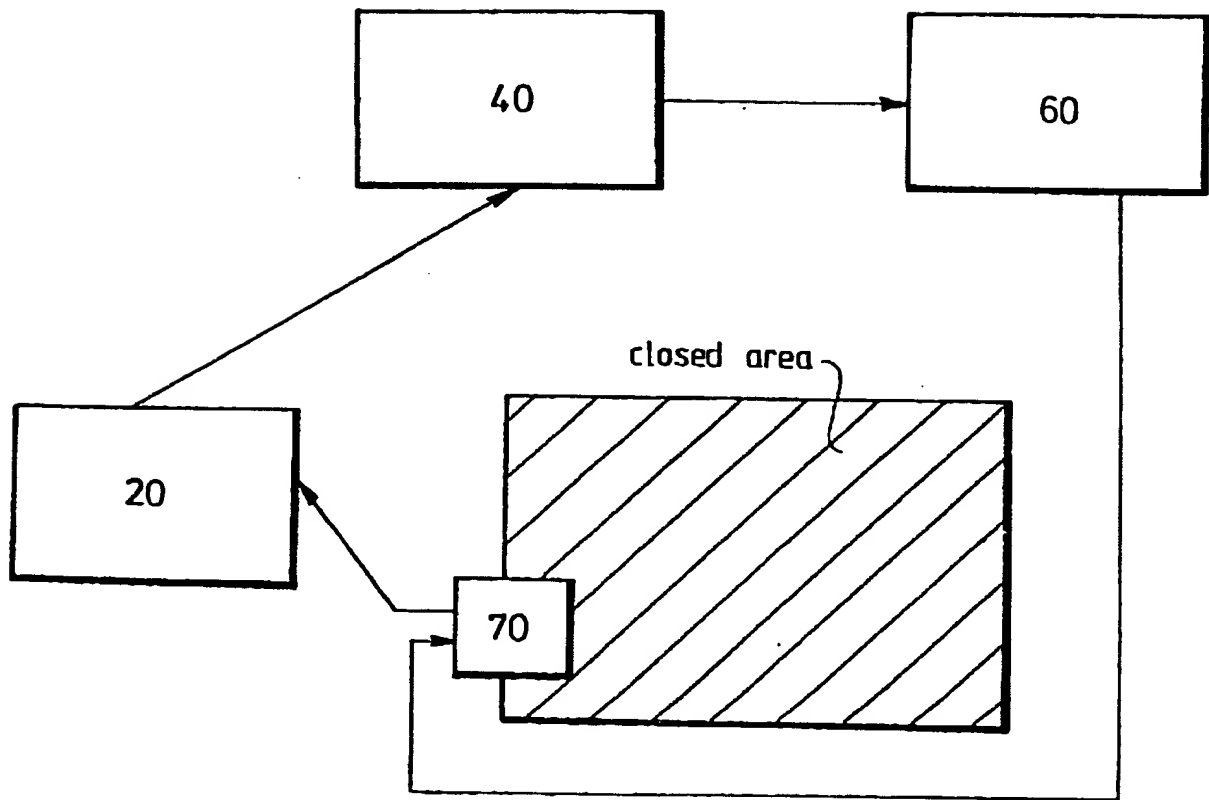


Fig.4

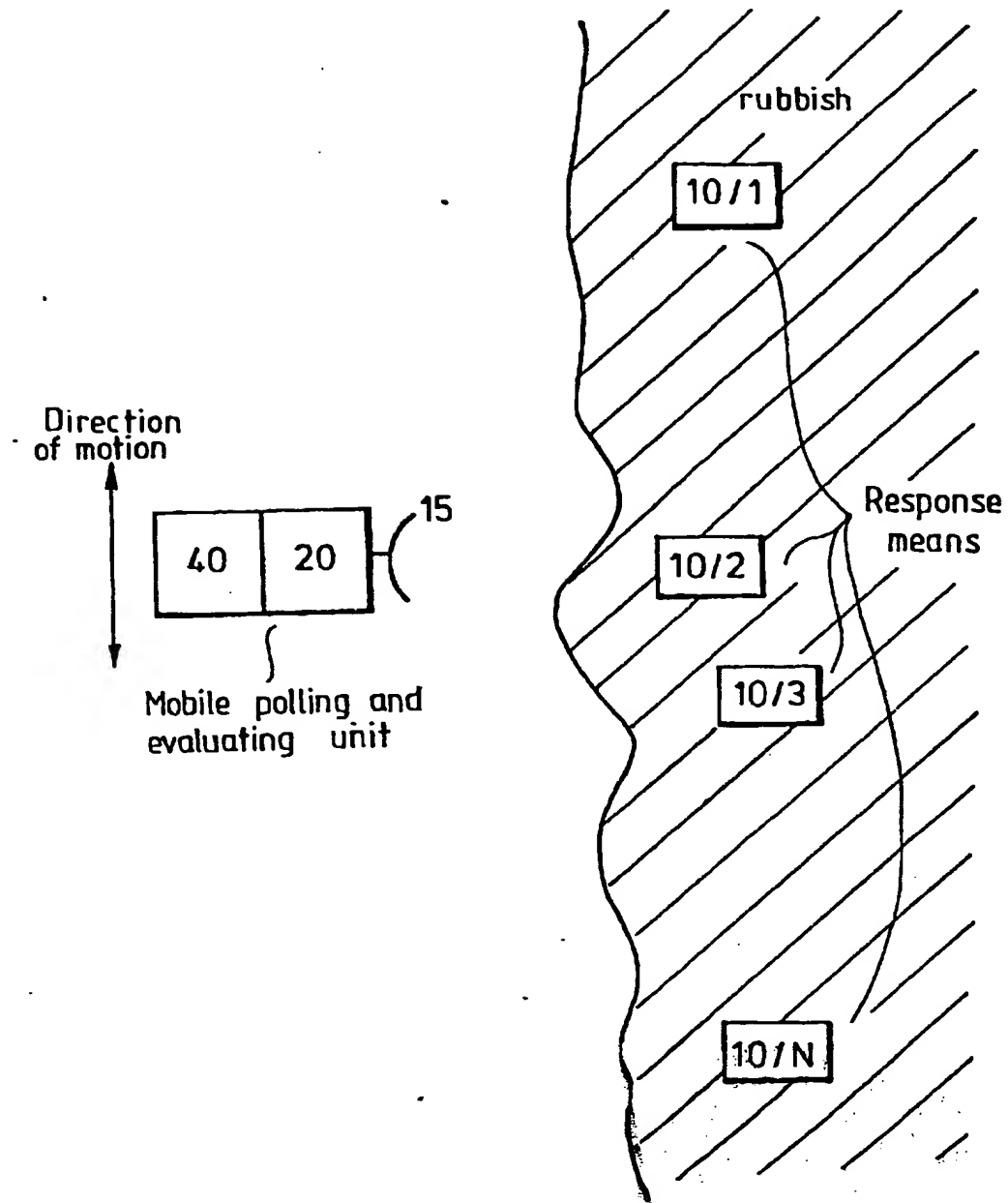


Fig. 5

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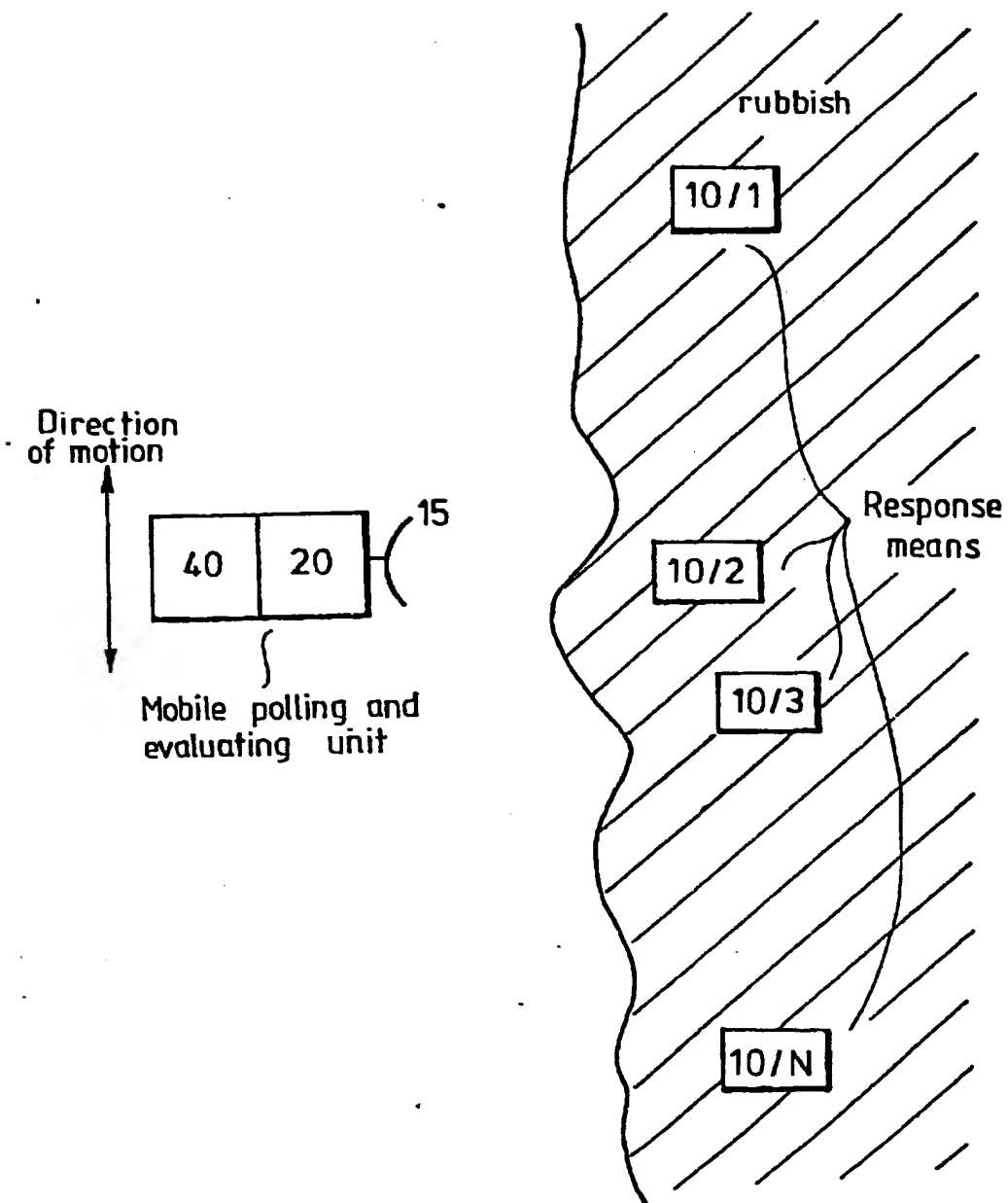


Fig. 5

## SPECIFICATION

**Process and circuit arrangement for the automatic identification of living creatures and objects**

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The invention relates to a process for the individual and automatic identification of living creatures and objects and following the motion thereof in such a manner, in so far as the polling (inquiry) means

10 arranged in different places address the active response means arranged on the living creatures resp. objects to be identified resp. to be followed one after the other, thereafter on basis of the responses received their presence resp. motion are evaluated.

15 The circuit arrangement consisting of the code transmitters, polling units, data collectors and nodal point pro-serving for the realization of the process - forms also the object of the invention.

The process can be used everywhere, where  
20 unambiguous co-ordination of living creatures and objects, as well as response means emitting different codes can be realized. In course of their motion they are crossing one or more fields in which they get into the sphere of operation of the polling units, resp.  
25 where it becomes possible to move the polling unit in order to search for the response means. The process can be applied in cases too, in which - from the point of view of practice - within the sphere of operation identification is to be performed  
30 simultaneously, however the number of response means within said field is unknown. The process according to the invention can be applied successfully in mines, or any other industrial plant for observing the positions and motion of the workers, for  
35 inhibiting or regulating the entrance in certain areas, for the control of different transport processes and tracing persons or objects in different operative defects resp. catastrophic situations.

The identification system of

40 REDAR-Nah-Ortungstechnik GmbH (Darmstadt - GFR) is well known and used in a wide circle, which functions on the principle of radar reflexion. The polling means transmits at a frequency of 433 kHz, the response signal has a frequency of 455 kHz.

45 In dependence of the velocity to be reached transmittance may take place in microwave systems too. The advantage of the system lies in that response means does not require a supply source, accordingly general service is not required. An  
50 unfavourable characteristic lies in that it is capable for the simultaneous process of the signal of one response means only, accordingly, velocity of traversing and field of traversing are restricted in the environment of the antennae.

55 The German Patent 2 151 105 (relating to the invention of the Swedish Institut for Mikrovaagtechnik) discloses a solution which is based on the microwave transmission. The polling unit transmits a high-energy microwave, a part of  
60 which is reflected by the response means with a modulation in compliance with the pre-adjusted code. The transmitted energy supplies the response means, so no separate energy source is required. At the same time the pre-requisite of the proper  
65 function lies in that the antenna of the receiver

should be nearly perpendicular to the transmitted energy in compliance with the character of the microwave propagation. It follows from the wavelength that a plurality of transmitting antennae  
70 are to be arranged on the field of traversing to cover the whole area; as a consequence, location of the system is rather expensive.

The System P.REM.ID of the Austrian Company ECOPLAN CONSULT GmbH is based on a

75 microwave system of the frequency 2450 MHz and it is used for determining and identifying the motion of persons. In addition to a plurality of transmitting antennae the system tries to reduce orientation sensitivity of the identification plaquettes or sheets  
80 (response means) by the arrangement of specially designed reflecting nets. According to experiences having been gained in practice, problems connected to errors resulting from direction sensitivity could not be solved by this system either. In comparison to  
85 other solutions the advantage lies in that identification sheets can be programmed by travelling before a transmitter (polling unit) set for this purpose, respectively, their codes can be changed. Due to the application of the microwave  
90 technics - similarly as the previously mentioned solutions - the system is expensive.

The solution according to the DE-PS 3 305 685 (SENSORMATICELECTRONIC CORP. USA) tries to eliminate the deficiencies involved in microwave  
95 radiation, accordingly, signals are transmitted at a lower frequency. Principle of operation is based on that upon the start signal transmitted by the polling unit the response means arranged on the controlled area start on a pseudo - random - digit generator. In  
100 dependence of the result thereof starting time of the response code will be different from that of the start signal and mutually. According to the patent specification - based on probability - simultaneously maximum six persons can be identified with a  
105 minimal probability of error. This solution requires also pre-regulation of traffic, which is to be considered as disadvantageous in comparison to earlier solutions based on microwave transmittance.

One of the first solutions of the object of the  
110 present invention is contained in the Austrian Patent 234762 (Siemens-Halske). This solution contains two transmitting system with one lateral band and common carrier frequency. Carrier frequency is produced by the polling unit and forms  
115 continuously, in the proper order of sequence the codes consisting of the basic frequencies. The method is restricted by the combination possibility of the basic code frequencies and the polling in due succession. At the same time, the technical solution  
120 yields the required effect only with closely coupled apparatus-pairs, so e.g. in course of identifying railway carriages.

The German Patent 3009179 (Strietzel, Reinar) assures synchronism of the frequencies of the  
125 polling unit and the response means in a most ingenious way. In accordance of the invention the response means separates from the signal having been transmitted from the polling unit carrier frequency - being smaller by an order of magnitude -  
130 modulates it with its own code and re-transmits it to

the polling unit. Energy of the carrier frequency signal suffices for the re-transmission.

From the character of the solution it follows, that simultaneously only the signal of one single response means can be received. A further disadvantage lies in that a relatively close coupling between polling unit and response means is imperative.

The process of General Precision Inc. (US) patented in USA and having No 3054100 is also known. In this case transmittance at radio frequency is used for identification. To achieve this, different audio-frequency identification signals are superposed onto the carrier frequency, said signals being simultaneously the identification of the apparatuses with the persons. When passing before the receiver of the polling unit identity of the person to be identified will be determined from the audio-frequency signal. The process is out-of-date, it is slow, and in case of synchronism it results in an interference which makes recognition of the signal impossible. For this reason progress in the proper order of sequence is to be assured by means of strict organizational measures.

The Hungarian Patent Specification HU-PS 185 482 gives a solution for the identification of persons in mines, being in connection with the object of the present invention. In respect to system-technical design it bears considerable resemblance to the solution according to the invention, however, when compared thereto, considerable disadvantages can be observed. For starting the code transmitter a strictly defined high-frequency magnetic field is to be crossed. At the same time, only the one single code transmitter can be arranged in said field, otherwise it may be happen that simultaneously several codes are transmitted resulting in errors in identification. In a dangerous situation starting one after the other required for individual identification cannot be realized, just in a situation, when tracing of people staying on certain places would be of utmost importance. In course of beginning and finishing work in high-capacity mines, when groups of a great number are in motion, individual passing could not be realized for the reasons of work organization and safety anyhow.

According to technical literature and practical experiences up to now practically simultaneous identification of people and objects being simultaneously present in a space could not be solved; neither relative independence of the receiver antenna of the polling unit could be solved without the danger that simultaneous activation of response means should cause detrimental disturbances in recognizing the identifying code.

The aim of the invention is to eliminate possibly the deficiencies of the solutions known up to now and to develop a process, with which response means being simultaneously present in the space do not disturb each other, intervals of address time and response time can be planned; in compliance therewith, audio-frequency signal to be transmitted can be chosen so that in knowledge of the expectable largest velocity of motion, the maximal number of the response means being simultaneously present

and distance of the apparatuses sensing traversing unambiguous identification free of any disturbance could be guaranteed.

The invention is based on the recognition, in so far as if response means are answering one after the other, in a proper order of sequence in the space covered by the polling unit, independently of the number of the living creatures or objects to be identified being present simultaneously in a given space, only one response means will transmit the response signal.

The aim set is achieved so that the polling unit - in knowledge of the possible number and codes of the response means - addresses continuously and in a proper order of sequence the single response means, which - if they are present in the space - are immediately activated and transmit a response signal. The response signal following the transmittance of the polling code indicates the presence of the addressed apparatus in the space, in addition, the response signal may carry individual informations too. After expiration of the time having been reserved for responding, the next code can be transmitted. After having finished the polling cycle the polling unit compares the signals received during the cycle resp. it starts the next polling cycle. The number of the objects to be identified determines the full length of the polling cycle. The arrangement of the detectors and the planned maximal velocity of motion of the response means determines the length of the intervals following of the single polling cycles, simultaneously avoiding the danger, that any response means could leave the space under transmission within the cyclic period. In knowledge of these, the required frequency can be determined, which ensures the needed length of cycle times, accordingly proper velocity of identification.

The polling units forward the informations having been formed during the cycle to the nodal point processors, which store the information set together with the identification of the places of detection and real time as long, as the central unit for identification receives them for processing.

The invention will be described in detail by means of preferable embodiments, by the aid of the drawings enclosed, wherein

*Figure 1* is the time-diagram of the informations of the identification cycles having been transmitted in course of the process according to the invention,

*Figure 2* the arrangement for realizing the process according to the invention, wherein the polling units are connected parallel to the nodal point processor,

*Figure 3* illustrates another possible embodiment, wherein the polling units form a loop and are connected so to the nodal point processor,

*Figure 4* with the embodiment to be seen here the identification unit is forming and forwarding a control or regulating information signal to the polling unit,

*Figure 5* is a further possible mode of realizing the process according to the invention, wherein the polling unit and the identifying central unit are capable of moving, while the responding means are fixed.



The invention will be described in details by means of the drawings.

The process is based on the recognition relating to the design of the identification cycle. As it becomes obvious from Figure 1, the whole cycle C consists of the series of the code sets K, while the number of the code sets corresponds to the number of the response means to be operated in the system. The first part of the code set K is the apparatus identifier code G having been transmitted during the polling time, while the second part is the response information V, which arrived during the response period.

As it is to be seen in Figure 2, the single elements of the arrangement are performing the following functions:

The response means 10 contains the call signal receiver 11 attuned to the predetermined frequency, the code comparing units 12, the transmitter control unit 13, the transmitter 14 transmitting the response signal, the antenna 15 required for the transmitter and receiver, respectively, as well as the adequate supply source 16. The polling apparatus 20 contains the single coder units 21 which produce the codes of the single response means, the circuits 22 controlling transmission and receipt within the cycle time, the call-signal transmitter 23 and the response signal receiver 24, as well as the memories 25 storing the result of comparison of the response signals and the evaluated compared informations. Data-transfer lines 30 manage the information traffic between the nodal point processor 40 and the data-transfer lines 30. The nodal point processor 40 controls the polling units, manages information traffic and stores the information set coming from the detectors, accordingly it consists of the data transmission control unit 41, the information processing unit 42 and the memory 44 for the informations. The central unit 60 is connected to a computer serving for operation control or any other special data processing unit. Accordingly, the central unit 60 consists of the circuits 61 controlling the nodal point processors, the information processing unit 62 and the memory 63 storing the informations.

In the arrangement according to the figure process of identification and comparison are taking place, as follows:

By the aid of the computer for operation control or any other coupled apparatus we determine the polling apparatus 20 which we intend to operate. Further, we determine the persons, living creatures or objects which are intended to be identified and followed and we determine the response means to be ordered thereto. In knowledge of the number of the response means 10 and the codes thereof the central unit 60 determines the composition of the polling cycles, control commands of transmittance and receipt, as well as order of sequence of the codes of the response means 10 within the cycle. Thereafter the nodal point processor 40 controls the polling units 20. The polling unit 20 operates during the cycle, as follows: It transmits the code of the response means 10 being the first according to the order of sequence. Thereafter it enters into receiving operation and if the response means 10 stays in the space of detection, on its call-signal receiver 11 it

recognizes the information destined through the code comparing unit 12 and controlling its response signal transmitter 14, it transmits the response signal. Now, the polling apparatus 20 verifies the occurrence of response and evaluates the individual information contained in the response and transmits the code of the response means being the second in the order of sequence. If the response means 10 is not present in the space of detection, after the expiration of response period it stops to the third code. The process is repeated up to the end of the cycle time, thereafter it begins over again. The nodal point processor 40 collects cyclically the informations coming from the detectors, provides them with the identification of the place of detection and time and forwards them to the central unit 60.

With the embodiment according to Figure 3 the polling apparatuses 20 form a loop, and so that the nodal point processor 40 may reach any of the polling units 20 on two ways. In such a manner data transmitter lines 30 become partly shorter, partly they guarantee double safety in case of eventual breaking of the lines.

Figure 4 illustrates another possible mode of realization of the process according to the invention. With this arrangement only the authorized persons may enter into the zone protected by the polling apparatus 20. For the sake of control, based on the re-transmitted code of the response means 10, the central unit 60 sends an inhibiting or permitting command to the final control element 70, which realizes final control in dependence of technical construction. So e.g. immediate stopping of a dangerous production line, if persons approach thereto, or closing the gates or sending an alarm signal, if a certain circle of persons approach to a forbidden zone.

A special possibility of application is shown in Figure 5. If the process is used for the establishment of personal identity, it can be successfully used for tasks directed to mine-security. In case of falling in of mines persons got stuck below or behind the slide rock can be traced so that by connecting the polling apparatus 20 with the central unit 60 and suitable portable supply source, as well as provided with a special antenna rescue teams can trace the place of catastrophe and the persons involved in the accident can be identified.

With any of the solution enumerated it becomes possible that the response signal should contain different additional informations, so in addition to identification, transmittance of informations relating to the condition of persons or objects can be realized, too: e.g. pulse or temperature of persons, fullness of railway carriages or other transporting means.

The main advantage of the process according to the invention lies in that possibility of simultaneous start of response means in course of polling - thus possibility of mistaken identity - is absolutely excluded. A further advantageous feature lies in that response signals may contain additional informations, accordingly, beside presence physical parameters can be transmitted too.

As a further advantage it can be mentioned that the process is independent of the relative position of

transmitting and receiving antennae, as a consequence simultaneous identification of larger groups can be performed without compromises.

From the point of view of operation - beside

- 5 favourable features, as enumerated - the disadvantage appears that response means function in an active mode of operation, accordingly accumulators or batteries require maintenance.

In the annexed claims reference numbers have

- 10 been used purely by way of illustration and convenience, and not by way of limitation of scope.

#### CLAIMS

- 15 1. Process for the individual identification of living creatures and objects and following the motion thereof, by the audio-frequency transmittance of polling signal and response signal, *characterized* in that within the complete polling  
20 cycle used for identification the code sets (K) consist of two parts, and the first member thereof contains the code (G) of the response means (10) summoned to response, transmitted by the polling unit (20) while the second member contains the response  
25 information (Y) re-transmitted by the response means (10) and the number of code sets following each other cyclically corresponds to the number of the response means to be operated within the system.
- 30 2. Process as claimed in claim 1, *characterized* in that the signal of the response means (10) contains in addition to the identification (V) further informations which are compared so that they are forwarded by the central unit (60) to the identifier.
- 35 3. Process as claimed in claim 1 or 2, *characterized* in that on basis of the existence and content of the response signal (V) the central unit generates further commands and transmits them to the final control element (70).
- 40 4. Circuit arrangement for realizing the process as claimed in claim 1, *characterized* in that for starting the response means (10) polling units (20) arranged on pre-determined places for receiving and processing the signals transmitted by said response  
45 means, said polling units are co-ordinated by nodal point processors (40), further, a central unit (60) controlling the nodal point processors and processing the information is contained, interconnected by the data-transmitting lines (30,  
50 50).
5. Circuit arrangement as claimed in claim 4, *characterized* in that in dependence of possibilities of physical location polling units (20) are arranged parallel with the nodal point processor (40) or after  
55 having formed loops, they are arranged thereon.
6. Circuit arrangement as claimed in claim 4 and 5, *characterized* in that the central unit (60) is connected to a separate control element (70) for control or regulation within the sensing zone of the  
60 polling unit (20) in dependence of the character of the response codes.
7. Circuit arrangement as claimed in claim 4, *characterized* in that the polling unit (20) forms a movable portable unit with the central unit (60), the  
65 specially designed antenna (15) and the supply

source (16).

8. A process substantially as herein described with reference to and as shown in any one of the Figures of the accompanying drawings.

- 70 9. A circuit arrangement substantially as herein described with reference to and as shown in any one of the Figures of the accompanying drawings.

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